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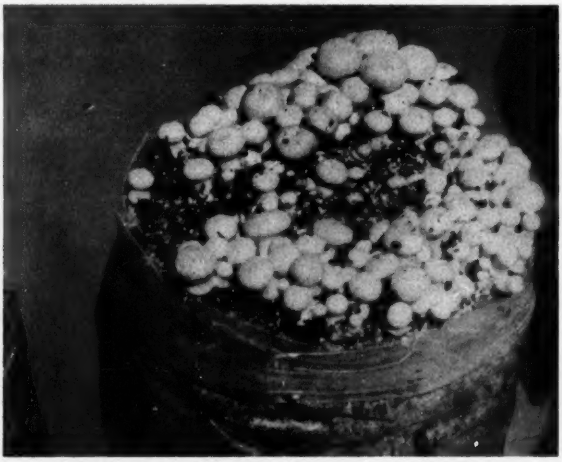

Fig. 1 Mushroom growing in polythene bags

Mushroom Growing in 1971

G. W. Ganney

WORLD production of the cultivated mushroom (Agaricus bisporus) has increased at an average rate of 25 per cent per annum during recent years. Annual production has increased in Britain over the past twenty years from around 6 million to over 100 million pounds, with a farm gate value of £13–£14 millions. This places us fourth in the world league table behind traditional producers such as the United States of America, France and a relatively new country to mushroom production, Tiawan. Many other countries are now taking up commercial mushroom growing and once the industry is established rapid expansion can be anticipated.

There are many reasons for this upsurge in world production, the most important being that technical advances have provided more consistent methods of culture, enabling the retail price to be reduced. Early production revolved around hazardous techniques when one could not be certain that a crop would be produced, let alone be economical. Today the grower is concerned more with economics and scale of operation, which demand higher and higher outputs to offset escalating costs and static returns.

Growing systems

Systems of cropping have evolved from ridge bed growing (see cover photograph) to shelves and small trays. In recent years, large tray operations have

been installed; Fig. 2 shows the first flush forming up on 40 sq. ft trays which have to be handled by automatic equipment. Another recent development aimed at lower initial investment cost is that of using polythene bags (Fig. 1). However, it is the large tray that has gained preference on many farms in this country with its advantages of reduced handling costs and labour requirements for picking, and its suitability for new production techniques.

Fig. 2 First flush of mushrooms on 40 sq. ft trays

Compost preparation

Crop processing commences with substrate preparation using horse manure or straw to which supplements, providing nitrogen and available carbohydrates, are added. Commercially, materials such as deep litter chicken manure, cotton seed meal, brewers' grains and hay are used to achieve the desired softening and breakdown of the straw. Phase I of composting has become more controlled. The use of automatic machinery, covered yards and routine analyses of raw materials and finished composts has helped to ensure that the chemical and moisture levels are maintained within the correct regime.

The process is completely aerobic involving pre-wetting the substrate material for a few days before forming stacks of approximately 6 ft square in cross sections that are turned at days 2, 4 and 7 for filling in trays at days 8 and 9 (Fig. 3). Such short composts are prepared in this way by many commercial firms. Use is made by many smaller firms of custom compost companies who prepare hundreds of tons weekly, transporting the prepared product over the whole country.

Trays are filled with compost and loaded quickly into the processing room, in order to minimize heat loss, for the beginning of Phase II—composting in a well insulated building. The importance of this Phase in relation to subsequent results cannot be over emphasized.

It is best to have a well insulated building that has a forced air system capable of providing an evenly distributed flow of fresh and recirculated air over the beds. Amounts of fresh air will be determined by the activity and quantity of compost in the building, but may involve over thirty complete fresh changes per hour on densely packed large trays. This phase of crop preparation is a continuation of the microbial husbandry started at the beginning of composting. Once the whole of the house has had the temperature equalized to 42°C (140°F), fresh air is introduced to maintain the compost at around 36–39°C (130–135°F), until microbial activity has been completed with all free ammonia being given off and temperatures starting to fall. At this stage, the compost should be cooled as quickly as possible to reduce undue wastage of food materials. The whole process may be completed in three to six days, depending on the basic material used.

Fig. 3 Automatic composting machine

Spawning

Once cooled, the compost is ready for spawning with one of the strains produced by specialist spawn producers. Spawn is cultured on rye or millet grain, being supplied direct by the producer in a fully run condition. Nearly all production in this country is on white strains with some off-white and cream strains being used for specific purposes such as canning or where mushroom virus is a problem. Through spawning is almost universally practised by producers in this country at 1–1·25 oz per sq. ft of bed area.

With new techniques such as through spawning, compression and large trays, fully automated machinery lines have evolved (Fig. 4). Such machinery can cost anything from a few thousand pounds to well over £30,000 for completely automated lines for operations of filling, spawning, pressing, casing and even emptying the old crop. Such lines handle thousands of feet of cropping area a day. Like all equipment, prototypes are soon superseded by more sophisticated equipment and it is likely that yet more will be seen on farms in years to come.

We have seen in the last two years the use of machinery that enables the crops to be harvested outside the cropping shed in a picking parlour. This has resulted not only in the crop being harvested at the right time, but also

in lower harvesting costs and more use of plant and equipment. It is very likely that such equipment will become more streamlined, with the possibility, eventually, of automated harvesting for processed or fresh mushrooms.

Casing

After spawn running for 12–14 days at a compost temperature of 23–24°C (74–76°F), casing with a mixture of chalk or ground limestone and peat is applied evenly 2 in. deep over the compost surface. Mushrooms will then be picked within 21 days. Cased trays are set up in controlled environment buildings able to provide fresh air to keep CO_2 levels below 7–800 p.p.m. while controlling temperatures at 16–17°C (60–62°F) and humidity at 86–92 per cent for cropping, and to provide heating to over 53°C (160°F) for 12–24 hours for cooking out.

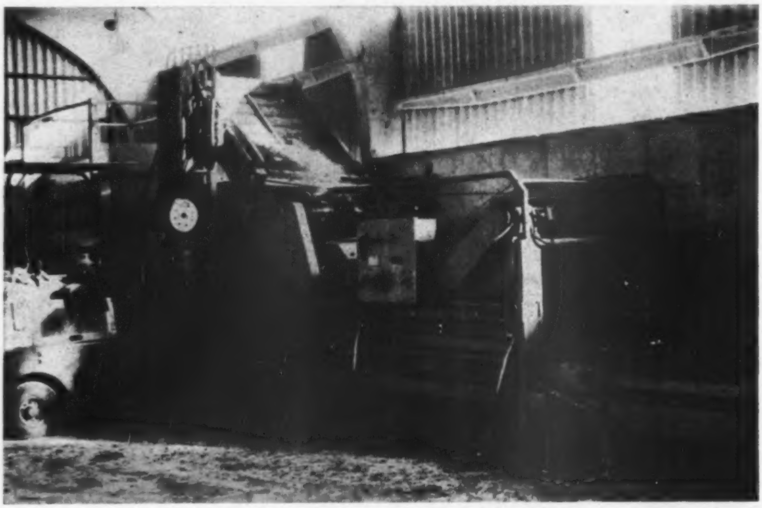

Fig. 4 Part of an automated line carrying out the casing operation

Economics

The need for specialized equipment and buildings means a high investment cost when setting up a mushroom farm; today, this is likely to approach £3 per sq. ft for a fully mechanized farm. This, coupled with the high costs of compost, packing, transport, fuel and labour (particularly picking costs at 5p a 3 lb chip), often add up to over 12½p a pound to grow. In fact, to overcome lower returns over recent years, 16p in 1965 to around a similar or slightly lower return today, higher yields have had to be produced.

The crop shown in Fig. 2 will yield between 3·5 to 4 lb per sq. ft in six weeks and each shed will hold over five individual crops a year (17·5–20 lb a sq. ft). This extremely high production is being achieved by the application of industrial development and technical knowledge on growing the crop.

Hygiene

Intensification of cropping always brings with it perils of pests and pathogens. The cultivation of fungi is no exception. In fact, a greater problem

exists in that controlling fungal pathogens such as *Mycogone perniciosa* and *Verticillium malthausei* on a fungal host is extremely difficult. For this reason a great effort must be made to preclude the entry of such pathogens by means of good farm design and layout and sound hygiene. With the heavy capital investment of building a farm, the filtration of incoming air to processing areas and rooms (Phase II), spawn running, etc. to below two microns is a vital insurance policy. The additional costs of air conditioning are insignificant when compared with the risk of losses due to pests and pathogens, particularly mushroom virus.

Mushroom virus can cause severe crop loss and may occur on new farms as well as those that have been established for a number of years. Transfer of the disease is by mushroom tissue either as mycelium on the growing containers, hence the need for efficient after-crop sterilization, or in mushroom spores. These spores can be efficiently removed only by filtering the incoming air and by reducing the level around the farm by filtering the exhaust air.

Research

Control of pests such as phorids (*Megaselia halterata*) has been achieved by incorporating organo phosphorus materials (Diazinon, Chlorvinvenphos) into the composts at spawning. The work at the Glasshouse Crops Research Institute has given excellent data on the epidemiology of mushroom pests, which has reduced pests to a lower plain of economic significance. We look forward now to work on systems of integrated control of mushroom pests along the lines successfully developed for glasshouse crops.

It is only at the Institute that mushroom work continuously takes place. Aspects concerning virus and other pathogens, genetics, nutrition, compost preparation and environmental control are all being studied. This necessitates a very close liaison with research personnel, which last year included a joint study tour to see the mushroom industries in France and Holland.

Research into husbandry techniques has been directed, in recent years, more towards the combining of Phases I and II, to the preparation of composts under controlled environmental conditions which are ready for spawning within a matter of days.

Future trends

It is likely that mushrooms will remain mainly a fresh product on the markets in this country due to the all-the-year-round supply and absence of preparation time or wastage in the kitchen. However, marketing processes have changed with increasing processing of crops both in cans and for deep freezing. As Britain is self-sufficient in mushroom production there may even be the possibility of a healthy export trade for processed goods.

With world consumption rising, there is every reason to assume a reasonable rate of expansion over the coming years for this crop. It is likely to be along the lines of high investment, for those producers who are successful appreciate all too well the enormous risk factors and will believe in investment to preclude problems and ensure continuity of output. Mushroom growing is not for the uninitiated or casual investor, it is a professionally precise biological technique.

G. W. Ganney, N.D.H., is National Mushroom Adviser serving with A.D.A.S. at the South Coast Glasshouse (and Mushroom) Advisory Unit, Bognor Regis, Sussex.

Assessing the extent of a typical snail habitat to be sprayed

Liver fluke eradication may be advanced by experiments in the Orkneys known as

The Shapinsay Project

Dr. G. F. Burnett

THE control of helminth parasites by elimination of their intermediate hosts is unusual in a veterinary context although it has been successfully done in the case of some parasites of man. It is, however, central to the planned elimination of liver fluke on the island of Shapinsay, in Orkney. In fact, a two-pronged attack is being made on the adult fluke in the cattle and sheep of the island and on the host of the larval form, the small mud snail (*Lymnaea truncatula*). This double attack is aimed at elimination and not mere control and although it is not expected that either attack would succeed by itself, together their effectiveness should be complementary. Put very crudely, if either measure alone reduces the chance of a fluke producing another adult to, say, 5 per cent of what it was, then the two acting serially should reduce this chance further to 5 per cent of 5 per cent, i.e., 0·25 per cent of the original. To increase the effectiveness of either dosing or snail-killing by a factor of 20 would be both expensive and extremely difficult, whereas to obtain the same effect by using the other method may be both cheap and easy. It must be emphasized that this is a research project, one function of which is to find

what level of reduction is required for effective elimination of transmission and there are no data available from which one could firmly predict the required degree of interference.

Project's sponsors

The project is a co-operative one between the Shell International Chemical Co. (molluscicide), I.C.I. Pharmaceutical Division (fasciolicide), and the Department of Agriculture of the University of Aberdeen (epidemiology, snail biology and general men on the spot). Shell have financed a research fellow of the University who has been investigating the biology of the snail in Shapinsay for the last two years. In particular, data on its annual cycle and the annual cycle of transmission has been needed to decide the most effective time to spray the molluscicide. This is N-tritylmorpholine (Trifenmorph) which was developed to control the snail vectors of the tropical human disease schistosomiasis. It has proved a very effective control for the mud snail and has the advantages of safety and few side effects—apart from amphibious snails it affects only fish, which should not come into contact with it on the farm. The fasciolicide used is Zanil. From the operational point of view one advantage is its wide margin between therapeutic and harmful dosage, as every hooved beast on Shapinsay has to be treated several times and this has to be done when many of them are pregnant.

Why Shapinsay?

The idea of carrying out a major trial of Trifenmorph in Orkney originated with Mr. J. D. Walker, a long-established veterinarian in Orkney, who has been a tremendous help in getting the scheme going and as being the University's unofficial liaison officer. He suggested several sites but for a number of reasons Shapinsay was chosen. It is as big as we could tackle and entirely devoted to stockrearing, with sufficient sheep to use the current lamb crop to monitor infection during each season. Very few animals are imported and it should be possible to check on these and dose them before they contaminate pasture; isolation is most important in any experiment aimed at extermination of a pathogen. The farming community is both progressive and very co-operative. Fascioliasis is present but is not so devastating that the experiment would be complicated by individual, unco-ordinated measures—in some farms in Orkney sheep are no longer kept because of deaths from acute fluke. Finally, the island is readily accessible.

Shapinsay covers 7,290 acres. There are sixty-six farms of which one is over 1,000 acres and the others of more even size. There are relatively small areas of unreclaimed moor and rough grazings. The island is very roughly L-shaped with a high point 211 ft above mean sea level and fields roll down from low ridges along each arm of the L to the beaches or low cliffs. The farms are compact and the cultivation divided into remarkably regular fields, almost square and often with ditches on three or four sides. Typically there are deep straight ditches running down each side of a row of fields to the sea, connected by transverse drains, often with low spots that form dangerous sources for snail breeding. If the delivery of the ditches is not over the cliff swampy patches may be formed and in some places perennial seepages along the cliff line are danger spots. There are also a number of natural swamps. The underlying rock is soft flagstones overlaid in most places with thin glacial

clay. The flags contain a good deal of lime and seepage water is hard; this favours *Lymnaea*. All crops are for fodder and most grazing is in rotation with oats, turnips and barley. Thus habitats of one year may be under a crop the next, and vice versa. The climate is a distinctly cool temperate and although hard frosts and snow are rare winter is long and windy and the cattle are housed from November to early May, while summer temperatures are too low for a rapid turnover of snails. There are about 3,500 cattle on the island, mainly sold off fat at two years—Aberdeen Angus are slow maturing but Shapinsay cattle win prizes at shows in the south. There are about 2,000 sheep, including the current lamb crop. Lambing in most cases is in April, lambs being sold fat from September onwards, mostly in the autumn.

Intensive observations

The experimental schedule is as follows. Preliminary observations on the snail have been made for two years. Batches of lambs have been bought off the farms each year at intervals and at slaughter the livers examined for flukes in order to find the principal season of transmission. Samples of the very numerous rabbits have been collected to assess their importance as sources of infection. About 2,500 faecal samples from cattle have been taken. Cattle are the chief source of infection and the samples should aid in locating where transmission is potentially most important. Observations have also been made on the invertebrate fauna and on lapwings and oystercatchers to monitor side effects. This spring all animals were given three doses of Zanil before the cattle were turned out. This will be repeated during the winter. In 1969 the island was surveyed by two zoology students from the University and all breeding sites, whether putative or confirmed by finding snails, were mapped. These, if wet, were treated with Trifenmorph in the second half of last June. One pound of active ingredient was applied in 30 gallons of water per acre and spraying will be repeated next year. The survival of snails and reinfestation of breeding sites is being followed and lambs will be grazed and slaughtered as before to detect residual transmission, if any.

These intensive observations will continue at least until late next summer and surveys will probably be made on a more selective basis in subsequent years to assess the permanence of any effects produced. Parallel observations are being and will continue to be made in a similar but untreated area on the adjacent mainland of Orkney. Any effect on cattle gradings and prices at market will be noted.

Long-term results

It is, of course, too soon to assess results with the experiment barely half completed. As so often happens in field research the weather has been unprecedentedly peculiar. Both 1969 and 1970 were unusually dry summers in Orkney, leading to a decline in infestation reflected in a fall from 60 per cent to 40 per cent in livers condemned for fluke in Kirkwall slaughterhouse.

This spring was again exceptionally dry and some exposed habitats were dried out when spraying was done. Because Trifenmorph is effective only in the wet, these areas were left but snails may have survived in them. Many wet places were teeming with large snails; these included about 90 miles of ditches, many of which were choked with vegetation and it was gratifying to find many dead snails in at least some of them after treatment. A striking

Spraying ditch banks. Ninety miles of ditches were treated as part of the project

feature was the abundance of snail in atypical habitats, e.g., overgrown and quite mudless ditches with stony bottoms, or with a thin film of almost dried mud. If a ditch was wet there appeared to be about four chances in five of finding snails within ten seconds of random search and so all were sprayed. This was a laborious business, much of it done with hand-operated knapsack sprayers, because many ditches, especially along farm boundaries, were guarded by barbed wire on one or both sides. Treating such a ditch when it is eight feet deep and only a foot wide at the bottom, and with perhaps nine inches of soft mud beneath banks clothed with rain-soaked nettles, can be recommended to any student looking for an out of the ordinary vacation job; in fact we had the valued assistance of three, who fully earned their pay.

The relatively low intensity of fluke infection on Shapinsay appears to be due to the large number of ditches and the good state of the many fences. In dry periods the snails persist in the ditches but in wet ones they reinfest the poached areas created by cattle circling the fence, and also areas that have been under crops. This process was noted some years ago in preliminary trials with Trifenmorph in Orkney initiated by the North of Scotland College of Agriculture. An interesting observation has been the complete lack of kill of other small snails, including *Potamopurgus jenkinsii*. This is very like a small *L. truncatula* with which it shared some ditches now littered with the dead shells of the latter and must be carefully distinguished if its persistence is not to be misinterpreted.

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Farming to suit the conditions, coupled with sound management and regular drainage maintenance, adds up to

Field Drainage After-Care

R. A. Walpole

WHEN crops are lost or yields fall well below average, the cause may be due to the soil being waterlogged for long periods. Such conditions, for the most part, will have been brought about by physical weaknesses inherent in the soil which are of geological or pedological origin. In many cases, the naturally poor drainage conditions of such a soil will have been aggravated by farming operations.

It is often said that it takes a year or two before the full benefit of an under-drainage system is realized. This is perhaps not surprising as the effects of stagnation in a soil under waterlogged conditions cannot quickly be relieved. It requires some time following the removal of surplus water before the natural processes of weathering, both physical and biological, take full effect and improve aeration. Good husbandry and the careful management of the soil will encourage the aeration process which, in turn, will bring the under-drainage system more quickly into full effect.

Field drainage systems are the means of providing man-made drainage in soils where the natural drainage is poor by creating a medium in which plant roots can live and grow without restriction. One effect of poor drainage is that root development is restricted so that during drought periods the roots cannot obtain sufficient water to compensate for losses by transpiration, etc. It is essential for roots to be able to develop and penetrate the surrounding soil in order to find enough water to maintain the plant in full growth; this may mean that roots must be able to reach a depth of three feet or more.

Drainage after-care covers many aspects of sound management. It may involve a secondary treatment, such as moling or subsoiling to thoroughly disturb the soil over the under-drainage system, and also the normal farm management problems of deciding the system best suited for the particular type of soil and what the fertilizer and cultivation requirements are; it also includes the regular maintenance of the field drainage system. Only by careful attention to all these aspects of after-care is it possible to obtain a full and sustained response from any drainage system.

Design for easy maintenance

To ensure the long and effective life of a drainage system it must be properly maintained. Although this is the last operation in the chain it should receive careful consideration at the design stage, the maxim being 'Prevention is better than cure'. But maintenance can be reduced and made

A well-built outfall

easier in a number of ways. For example, ditches should be excavated to dimensions slightly in excess of the minimum drainage requirement to cater for the deterioration of the channel. Care should also be taken to form stable ditch batters, choosing flatter slopes where silt or sand predominate. The ditch bed should be graded evenly so that water flows at a steady speed thus preventing accumulations of silt.

With pipe drains good, uniform gradients help to keep suspended matter in the water moving along the pipes, so avoiding a build-up of sediment. Carefully located silt traps at main junctions and purpose-made junction pipes for the smaller lateral drains all help to prevent silting.

A well-built under-drainage outfall is most important; in many cases if it becomes blocked or collapses the rest of the drain system will fail. It is well worth the extra trouble to ensure that an outfall is installed which will last for the entire 'life' of the system and is proof against vermin and erosion during periods of high flow in the ditch. The outfall should not be elaborate, it merely needs to be firmly fixed and not liable to obstruct ditch flows. The under-drain layout should be kept as simple as possible. This not only helps in locating the drains in the future but also makes maintenance by rodding or jetting more simple. The inclusion of too many main drains increases the risk of blockages at junctions, while drains with separate outfalls into the ditch are easy to locate and clean, particularly if a marker post is positioned at the outfall. Anyone concerned with the installation of grant-aided field drainage schemes can obtain a copy of the Technical Note on Workmanship and Materials* which gives guidance on the more important points in the design and installation of field drainage systems.

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*Obtainable, free, from local offices of the Ministry, or from the Ministry of Agriculture, Fisheries and Food (Publications), Tolcarne Drive, Pinner, Middlesex HA5 2DT.

Operational points

It is essential that drainage work should be carried out by experienced men using efficient machinery and good-quality materials. The work should be carefully programmed to be carried out in fairly dry field and soil conditions. Work should never be undertaken when the surface is so wet that the drainage machinery can damage the soil. If the subsoil is too wet, machines can smear the sides of the trenches sealing over the natural soil fissures and so prevent the movement of soil water to the drains. Ideally, the work should be done in the late spring or summer; if necessary, it is worth sacrificing a little of the crop to ensure that the timing of the operation is correct. Often any damage incurred will be outweighed by improved drainage performance and increased crop yields.

The soil conditions surrounding the pipe in the bottom of the trench vitally affect the ultimate efficiency of the system. Soils which are slurried or too soft along the pipe bed penetrate and seal over the joints and so prevent the drains from working efficiently. In these circumstances it is doubtful whether the system would ever become fully effective.

A drain laid through the crop by the 'trenchless' method

Poor drainage conditions and soil structure

Mention has already been made of the need for complete aeration of the soil. The design of the drainage system should already have taken into consideration the condition of the soil profile and the characteristics of the soil texture and structure, as these determine the permeability of the soil and hence the design principles. Structural problems seldom exist in coarse-textured soils where the drainage systems are designed to control the movement of ground water and reduce the level of the water table. On the other

hand, surface water drainage is strongly influenced by the tendency of a soil towards structural instability which shows itself in the development of a surface crust or subsoil pan. These create unhealthy soil conditions and cultivation difficulties by reducing permeability and restricting the movement of water, so aggravating the drainage problems. Although a drainage scheme may be designed for a degree of permeability in the soil relative to the texture or soil particle size, this capping and panning could render the most intensive drainage system completely ineffective; these conditions should be recognized and dealt with.

The structure of a soil is the manner in which its components such as sand and clay are arranged within the soil mass; these adhere together by natural processes to form larger aggregates with spaces in between. The characteristics of the components and the degree of development of the spaces or cracks determines the amount of air space in the soil and consequently its permeability.

With clay soils and those with a high clay content, structure plays an important part in the aeration process, as the close packing of these fine-textured soils does not allow sufficient pore-space between the particles to provide the right conditions for the free movement of water and air; this movement can take place only in the structural cavities and fissures in the soil. Soils with a well-developed structure are usually stable; in other words, they do not easily collapse under wet conditions but retain their form and continue to allow water and air to move freely through the soil down to the depth of the drainage system. The need for sub-surface treatments and cultivations arises from the presence of structural weaknesses or pans.

Identifying structural problems

It is necessary to examine the soil profile down to depths of three to four feet in order to assess the nature of the soil structure and this should be done before the drainage scheme is installed. A further check of the open trenches whilst work is in progress provides an ideal opportunity to see the soil profile in greater detail. A visual examination can soon reveal the physical weaknesses that may exist and the layers of low permeability, whether these are caused by over-compaction or arise naturally.

Mechanical treatments

Some field drainage systems are designed specifically with sub-surface treatments such as moling or subsoiling in mind. In these, the under-drains are covered with a permeable backfill material such as stone or clinker to act as a connector to the under-drains. These deeper operations to disturb the soil are carried out to overcome deep structural problems and are an integral part of this type of under-drainage system. In soils free of deep structural problems pure under-drainage systems are installed. Nevertheless, due to untimely cultivations or poaching by stock, shallower pans can form and these will need breaking up by light sub-soiling or even by the use of a chisel plough or heavy cultivator. In all cases the type of subsoil operation is determined by the depth of the problem layer.

It is true to say that the majority of soils requiring a drainage improvement show evidence in the profile of compaction caused by previous cultivations. The compaction is usually to be found just below ploughing or cultivation

depth. In the treatment of these 'hard pan' problems the main requirement is to carry out the work when subsoil conditions are dry and to make sure that the horse power of the tractor used is sufficient to pull the equipment without causing further damage to the soil surface.

Cultivation on soil which is dry on top but too wet below, resulting in 'smearing' and the formation of a pan

Cropping and good management

Difficult soils. With such soils cropping should be planned to suit the particular soil type. On the more intractable soils, particularly those with an unstable structure which can lead to slaking and capping, frequent arable cropping and the consequent damage to soil structure makes the removal of excess water very difficult, especially in areas of medium to high rainfall and where root crops are included in the rotation. Additionally, some forms of arable cropping can lead to reduced levels of organic material in the top soil. On borderline soils such as these it may be wise to change the farming system so that soil structure and susceptible crops are less at risk in wet seasons. It follows that such basic changes in farming enterprises should be made only after fully considering all the farming circumstances.

Stock. The need to maintain good soil structure applies equally to grassland farming and stock management. Among the more frequent causes of damage to soil structure by stock are:

poaching or treading on heavy land during wet periods or where stocking rates are high;

turning cattle out too soon in the spring or leaving them out too long at the end of the grazing season;

strip grazing winter forage crops on heavy land.

Arable. One of the main aims of good management on arable land is to ensure that damage to soil structure is kept to a minimum. It must be realized that drains do not pull water but only receive the ground water which gravitates to them. Neither will water penetrate compacted or puddled layers

to reach the drains. Cultivations should be carried out only when the soil is dry enough to resist damage to its structure, and this requirement applies not only to the soil surface, where the effects can readily be seen, but also to the soil below, where the pressure of wheels and implements is likely to cause compaction. If there is any doubt about the soil moisture content being too high, it pays to dig down to the intended depth of cultivations before starting work to make sure that the soil is not too wet and plastic.

Drainage maintenance. Drainage systems must be kept in good order if they are to function efficiently. Free-flowing ditches are most important, and any blockages due to weed growth or bank slips should be quickly removed. Too much stress can never be given to the importance of early autumn attention to the annual maintenance task of keeping ditches clean, clearing outfall pipes, removing silt from inspection chambers, cleaning inlet grids, and finding and marking old drains, etc. A plan of the pipe drain outfalls is one of the most useful documents on a farm; it saves time and labour in searching for them and also ensures that none are missed.

Future care. In addition to normal maintenance, some of the soil treatment operations described may need to be repeated from time to time, and it is worthwhile examining the soil profile to ensure that the subsoil remains in good condition. The sound practices advocated for the management of the land should continue in order to prevent a recurrence of the original poor drainage conditions.

R. A. Walpole, M.I.Agr.E., is a Senior Drainage and Water Supply Officer with A.D.A.S. at Chelmsford.

European Poultry Conference for London in 1972

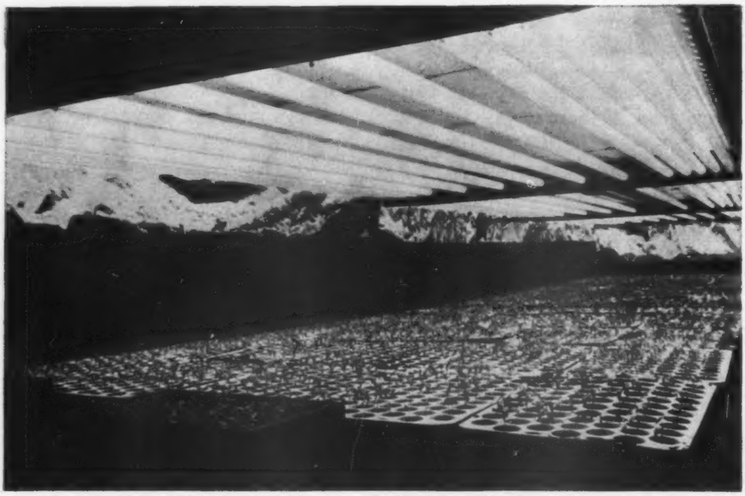
Many will regret there will be no International Poultry Show this year. But September 1972 will see the completion of one of the most ambitious projects ever to be put into the British poultry calendar. The occasion will be the five day 4th European Poultry Conference, which will be held at Olympia, London, in association with the International Poultry Show. Not only has the Show moved from its traditional date in December in order to combine with the Conference, but the event also has the support of the Poultry Industry Conference Committee, which has decided not to hold its annual Eastbourne Conference in October, 1972.

The Conference promises to be unique, and the organizers have been at great pains to ensure that the subjects and speakers shall have a greater appeal than ever before to the practical poultryman as well as to the scientist.

Eighteen symposia sessions have been arranged, broadly covering the subjects of economics, husbandry and health. Arrangements have also been made for the delegates to visit establishments concerned with veterinary, nutritional, and commercial research, combined with visits to places of natural and historic interest.

With the Conference and the International Poultry Show under one roof at Olympia, the event will provide an unprecedented opportunity for practical poultrymen, trade interests and the scientist to come together.

Further information can be obtained from Mr. C. J. Harrisson, Agriculture House, Knightsbridge, London, S.W.1. (Tel. 01-235 5077).



Lighting unit suitable for use with lettuce or tomato seedlings

Supplementary Lighting on Glasshouse Lettuce

D. J. Fuller

SUPPLEMENTARY illumination of plants in the propagation stages has been practised for many years but interest increased tremendously with the building of the first commercial growing rooms some six years ago. These rooms, which relied entirely on artificial light, were built primarily for bedding plants or tomatoes and, at first, lettuce seedlings were included only as a sideline. There was an increasing demand for quality lettuce in winter, however, and this crop, which is normally propagated in the poor light period of the year, has proved to be an ideal subject for illumination. Seedling growth is much faster than in natural winter light and with a crop being grown for its leaf the establishment of a large photosynthetic leaf area early in the life of the plant has a 'compound interest' effect which lasts through to the time of harvest. Illumination of seedlings has therefore become a standard practice on many nurseries in the North.

Lighting requirements

Illumination is provided by warm white fluorescent tubes, suspended 18 in. above the propagation bench. The early growing rooms had double walls with the flourescent tubes mounted over tiered benches in the inner chamber.

The side walls of the inner chamber were constructed of perforated hardboard so that a fan could be used to re-circulate the air through the space between the double walls and across the chamber; this provided an even distribution of temperature and prevented over-heating of the tubes which would impair their lighting efficiency. An automatically controlled louvre regulated the entry of fresh air from outside when the temperature became too high, and an electrical heating unit was included to guard against low temperatures.

A number of these rooms are in use in the North-West but they are relatively expensive to construct and the tiered shelves are difficult to fill and empty in any large scale operation. Trials proved that the same lighting equipment could be used over glasshouse benches to produce the same results, provided that the grower had automatic control of the glasshouse heating system. Consequently many people with well heated propagation houses have used glasshouse bench lighting in preference to the building of special growing rooms.

Warm white 125 watt fluorescent tubes 8 ft long are used and most units have been constructed to give an illumination level of either 5,500 lux or 11,000 lux. Seven tubes are required across a 3 ft 6 in. bench to give 5,500 lux, while thirteen are required to give 11,000 lux. These high numbers of tubes are necessary because of the fall-off of light intensity at the edges of the bench and considerable economies in construction costs can be achieved by making continuous banks of tubes extending for many feet. Used in this way tubes can be spaced approximately 1 ft apart for the lower light intensity or 6 in. apart for the higher intensity.

5,500 lux lighting units have been used to give continuous lighting for most of the work with lettuce while 11,000 lux units have been used for tomatoes. Where tomatoes and lettuce are grown it is necessary to use the higher light intensity on a basis of 12 hours on and 12 hours off. However, recent work at the Ministry's Fairfield Experimental Horticulture Station has confirmed that 5,500 lux for 24 hours per day is the better treatment where only lettuce is being grown.

In constructing lighting units for either growing room or glasshouse use it cannot be emphasized too strongly that great care must be taken to ensure that the electrical equipment is safe for use under damp conditions.

Treatments compared

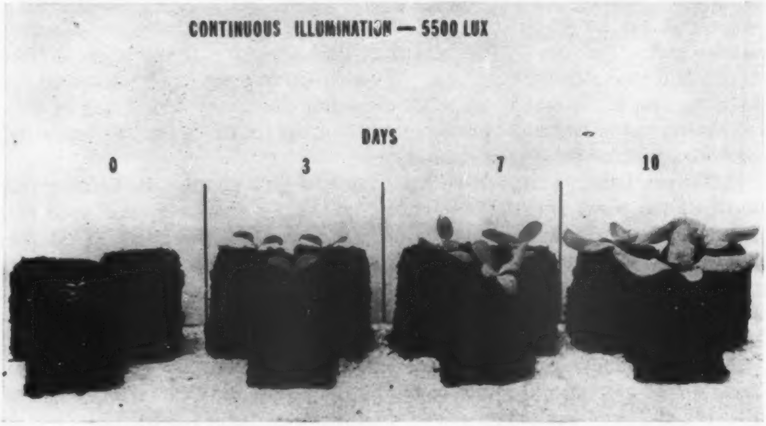
At first, attention was directed to the raising of lettuce seedlings up to the pricking out stage. Three days (72 hours) of continuous illumination at 21°C (70°F) immediately after germination will give a first class seedling with well developed seed leaves. The propagation period can be shortened by approximately five days in October rising to ten days in mid-winter. In addition there has been a saving of 5–6 days in the growing house time under most conditions and the effect of the treatment carries through to give some improvement in market quality. Seed can be sown at rates up to 600 per sq. ft and on this basis an 8 ft × 3 ft 6 in. illuminated bench can produce 15,000 seedlings every three days at a lighting cost of approximately £1.

The next logical step was the use of longer periods of illumination. This involved the illumination of seedlings after pricking out into soil blocks or other containers. At first glance the costs appeared prohibitive because of the reduced plant numbers which could be accommodated under the lights

but further investigation showed that the growth response was sufficiently rapid to make the system worthwhile for a limited number of intensive growers who wish to obtain the maximum output of lettuce in a given time. Using an 8 ft × 3 ft 6 in. bench and seedlings in 4·5 cm soil blocks a lighting cost of £1 will produce only 400 plants in ten days. The cost per plant can be halved by the use of the larger lighting units.

In return for the extra cost a lettuce plant can be produced in just over two weeks compared with six or more weeks for one grown in natural light in mid-winter. This means a saving of 30 days in the propagation area and in one experiment with the variety Miranda there was an overall saving of 40 days from sowing to cutting. Greater precision is achieved in planning sowing dates for successive cropping and the lettuce produced is usually of superior quality.

This ten day treatment was tested experimentally and is in use by a number of commercial growers. Longer periods of treatment are being tried experimentally but growers must remember that there is in this a danger of predisposing the plants to bolt without first forming heads.



Lettuce seedlings showing rapid response to lighting treatment

New developments

The-large scale treatment of lettuce seedlings and the requirements of specialist tomato propagators has led to further developments in the design of lighting units. The result has been the development of 'linear growing rooms' which are a compromise between growing rooms and glasshouse bench lighting. They consist of continuous banks of fluorescent tubes mounted in any building where adequate control of temperature can be achieved. The first of these was constructed in a converted broiler house and the next in a black film plastic tunnel. The use of large banks of tubes gives maximum use of the light from each tube and by mounting the units on rails one set can be used for two batches of plants where a 12 hour on/12 hour off basis is used. Filling and emptying of the rooms is considerably easier than with the original growing rooms, since tiered benches are not used and the plants are stood on the floor. For the future it may also prove

beneficial to provide carbon dioxide enrichment of the atmosphere to induce even more rapid growth.

Fairfield E.H.S. has recently been investigating the effects of sowing seed thinly in seed boxes for the ten day lighting treatment, instead of pricking out into soil blocks. Preliminary results indicate that this can be done without any really adverse effects while the cost per plant is less because greater numbers can be accomodated at any one time. Alongside improvements in the propagation techniques further investigation will now be needed of the work by Mr. D. J. Dennis and Dr. W. M. Dullforce at Nottingham University, which indicates that there is a beneficial effect from giving illumination at low intensities with fluorescent light in the growing house, particularly with plants which have been given high light intensity during propagation.

To sum up the present position, the three day treatment of seedlings with continuous illumination has undoubted beneficial effects for winter propagation and is in standard use in the North. Longer periods of treatment can be used by the intensive grower aiming for maximum throughput. Further developments can also be expected in both growing techniques and equipment.

D. J. Fuller, B.Sc., N.D.H., is Regional Glasshouse Crops Adviser with A.D.A.S. at Leeds.

FOWL PEST

The report of the Fowl Pest Review Panel was published on Tuesday, 12th October, 1971.* The Panel concluded that all concerned must make an all-out and sustained effort to establish and maintain a voluntary partnership between the Ministry and the industry to secure the optimum degree of voluntary vaccination and improved hygiene.

A new advisory leaflet† has been prepared and sent to all known poultry keepers urging them to undertake vaccination and providing detailed advice on vaccination programmes and methods of vaccination relating to all types of vaccine now approved for use in this country.

*'Newcastle Disease Epidemic 1970-71—Report of the Review Panel' (Command 4797) Obtainable from H.M. Stationery Office, price 30p (32½p by post).

†*Fowl Pest Control Advice to flock owners.* Copies obtainable free of charge from local offices of the Ministry or from the Ministry of Agriculture, Fisheries and Food (Publications), Tolcarne Drive, Pinner, Middlesex, HA5 2DT.

Sonic Booms and Horticultural Buildings

A. G. Jenson

THE phenomenon known as the sonic 'boom' or 'bang' has caused much speculation in the horticultural industry about the possible effects to property and individuals. It was early in 1968 that the National Farmers' Union expressed concern about what could happen where there are large areas of glasshouses, particularly in the south of England, and articles appeared in the horticultural press expressing anxiety about the effect on workers in such houses.

The sonic boom

It is now well known that when an aircraft flies at speeds greater than that of sound, pressure waves are created which form a conical pattern following the aircraft and may extend for some 25 miles on either side of the line of flight at ground level. It is within this area, known as the 'carpet', that the boom is heard and where the pressure waves technically referred to as 'over-pressure' may cause damage. Normally the sound is heard as two distinct booms in rapid succession, but due to atmospheric conditions and the very short time between the waves the effect may sound like only one.

A series of experiments carried out in the United States over several months, and two short experiments in Britain, established that the over-pressure is normally 2 lb per square foot (95·76 N/m^2) and that such a pressure would not cause any damage to structurally sound buildings.

Concorde fears

In the autumn of 1968 public interest became centred on the Concorde project, more particularly on the British version, Concorde 002. Speculation arose on the effect this aircraft would have on buildings and livestock when it flew at supersonic speeds over land. It was expected that test flights would be carried out over the North Sea towards the end of 1969 followed by extended tests over what is known as the West Coast route, a line of flight which would take the aircraft from Scotland across the westernmost tip of Wales and over the centre of Cornwall.

An extract from a report of the Select Committee on Agriculture appeared in the press in November 1968 suggesting that Concorde should avoid areas where glasshouses were concentrated. The view was expressed that whilst sonic booms would not be likely to break glass, they might break the putty seal.

Simulated boom experiment

Some apprehension was felt in July 1969 when a report appeared in the national press that naval aircraft, ranging from Swordfish to Phantoms, caused damage during a flying display at Lee-on-Solent.

It was then decided to carry out a series of limited experiments at the Ministry's Experimental Horticulture Station at Efford. Sonic booms would be simulated by using ground explosives which could be controlled to produce overpressures similar to those expected from Concorde. A series of experiments was planned by the Ministry of Technology staff from the Royal Aircraft Establishment, Farnborough, in collaboration with the Building Research Station and the Chief Architect's Office of the Ministry of Agriculture. The tests were designed to be directed specifically on to a block of old timber Dutch-light structures which were due for replacement, and on to two newly constructed aluminium clad wide-span glasshouses, somewhat to the dismay of the station Director who estimated the possible damage to his crops could be as much as £8,000!

The experiments were carried out over a five-day period in October 1969. Explosive charges comprising an explosive rope (known as ERDE) were laid out on 6 ft high posts directed at right angles to the target and point charges on taller posts, known as 'crackerjacks', were erected and detonated after a dramatic Cape Kennedy-type countdown. Scientists from the Royal Aircraft Establishment, in collaboration with Southampton University, arranged for instrumentation of the various structures to measure any resulting movement. A detailed visual observation was carried out by Ministry of Agriculture observers which was done by preparing a series of diagrams of glasshouses on the station drawn to show every individual pane of glass in the roof and side and end walls. Cracked or missing glass was marked before the commencement of the experiments. Following every detonation a rapid inspection was made and any additional damage marked and identified on the drawings by the use of a different colour or device.

A press conference was held before the tests and another at the conclusion, when reporters and others stood inside one of the Dutch light structures whilst a particularly heavy charge was detonated. There was no damage to the structure, or to the reporters.

The tests involved a lot of preliminary work in notifying local officials, the police and even the coast guards, who might have mistaken the bangs for distress signals at sea. Subsequent enquiries of people living in the immediate neighbourhood confirmed that the bangs were either not noticed or were heard only indirectly.

Results

The results of the Efford tests were that there was very little damage other than slight cracking. This occurred in the recently built aluminium clad wide-span glasshouses adjacent to the glazing clips where the glass is in any case under stress; and other cracks appeared in the older timber-framed glasshouses. There was virtually no damage to the old Dutch light structures because they are dry glazed; although the glass rattled there was no breakage.

The national press featured the results of the tests, one newspaper recording that 'So far the glasshouse at Efford Experimental Horticulture Station near Lymington has stayed in one piece but the scientists are having a rattling

good time'. The horticultural press headed its reports 'Experts are confident that Efford test bangs will end glasshouse fears'.

Regarding fears of the effect on workers, the Director of the Efford station said 'our workers who were withdrawn from the houses as a precaution when the tests started got quite blasé about them before the end of the series. They said they would be far more concerned at the effects of high wind'.

Concorde test flights

The press announced in February 1970 that Concorde 002 was likely to fly the West Coast route and the Ministry of Technology proceeded to arrange a comprehensive programme of scientific observations. These ranged from measurements along the flight route at three cathedrals, at ancient monuments and modern buildings, on livestock and even on the cliffs at Tenby to see if the boom dislodged any part of them. The code name *Exercise Trafalgar* was allocated and an early warning system operated whereby everyone involved received 24 hours advance warning of a possible flight.

The Ministry of Agriculture, Fisheries and Food took the opportunity of making visual observations at the Rosewarne Experimental Horticulture Station, Camborne, near the centre of the flight carpet, by using a technique similar to that at Efford. The first boom was heard there on 7th October 1970; this was a double boom and was followed by others a few days later (10th and 12th October). No significant damage was reported; there was slight cracking of the glass in the glasshouses but no structural damage at all to other buildings. During Concorde flights the Ministry of Aviation Supply (formerly Technology) also carried out simulated boom experiments at Rosewarne. The purpose was to compare the effects of simulated booms with Concorde booms under identical atmospheric conditions.

Conclusions

It would appear that the sonic booms created by Concorde are not likely to cause damage to sound structures although some damage may occur to dilapidated properties. Because of the probable prohibition of supersonic flights over land, the Ministry of Aviation Supply does not propose to conduct any further experiments for the time being. Nor will any investigations be carried out to test the validity of another 'phenomenon' which was reported at the time—that egg production increased during the period of the bangs!

The author, **A. G. Jenson, M.B.E., F.R.I.B.A.**, is a Senior Architect with A.D.A.S., London.

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Restrictions on the use of Aldrin, Dieldrin and Heptachlor Cereal Seed Dressings

To avoid harm to wildlife, farmers and agricultural merchants are reminded that cereal seed dressings containing aldrin, dieldrin or heptachlor should be used only on wheat seed for autumn sowing and then only where there is a serious risk of damage by wheat bulb fly. Seed treated with such dressings should not be sown after 31st December and an alternative chemical should be used if there is any likelihood of sowing being held over beyond this date.

Alternative seed dressings for autumn and spring drilling are now available. Advice on the best ones to use and on the likelihood of damage by wheat bulb fly in any area may be obtained in England and Wales from the Agricultural Development and Advisory Service or, in Scotland, from the Advisory Officers of the Agricultural Colleges.

Part of the dairy herd at Making Place Farm

From the West Riding—a farm worker with purpose and ability who made a

Success in Dairy Farming

Wesley Patterson

MANY people claim it is impossible to start farming commercially today unless you were born with a silver spoon in your mouth. Philip Hall of Making Place, Soyland, West Riding, has proved them wrong. He was a farm worker who became a farm manager and, by 1952, had saved sufficient money to buy a small 33-acre Pennine farm and fifteen cows. By his own skill and effort, and with the help of a bank manager who had faith in his ability, he now owns 82 acres, rents a further 20 and has sixty-two cows and their replacements.

Making Place Farm

The farm is about 800 feet above sea level. Although the soil is naturally poor, by using heavy dressings of lime and fertilizers and because of the high rainfall and high humidity there is plenty of grass. However, the winters are long and hard and the lack of sun and high precipitation makes it difficult to make really good silage.

Expansion

Philip Hall has many qualities but his excellent cowmanship and his ability to get cows to milk well is one of the principal reasons for his initial success.

Without these qualities, by starting at such a low level it is doubtful if he could have made a living and provided the extra capital needed each year for expansion. Progress was necessarily slow at first but by 1965 the dairy herd had increased to twenty-seven, with fifteen sows kept for the production of weaners; the margin over feed was £2,700. In that year nine acres which were being rented became available to buy and the bank agreed to advance him the purchase price.

Cow numbers by this time were increasing at a reasonable rate and grassland was improving apace. Within a year the herd numbered thirty-three and the margin over feed had increased to £107 per cow so that the total margin over feed had gone up to nearly £3,600. In September 1967 he added a further 40 acres.

New buildings for old

It now became obvious that as the stocking rate increased serious thought had to be given to preventing the workload becoming excessive. Although fully stretched financially, plans were made to convert the cowsheds to loose housing and, ultimately, to parlour milking and self-feeding of silage. Increasing cow numbers fairly rapidly, without increasing the bank overdraft, was very important, so the capital available for alterations was very limited.

Old store building converted to cubicle housing

In 1968 a start was made by converting the old, thick-walled, stone buildings to cubicle housing. Knocking holes for new doorways and demolishing complete walls to give a good future layout while, at the same time, supporting a very heavy roof and loft would have daunted many builders; but not Philip Hall and his fifteen-year-old son. By hard work and judicious buying of second-hand timbers, railway sleepers, pitch pine beams and steel

stanchions, a first class layout for 60 cows, plus a concrete floored yard and open silo, was prepared for the incredibly small sum of £600—with no charge being made for much sweat and occasional tears!

The next big financial hurdle was to install a new herringbone milking parlour in an existing building; this cost about £1,000. Adjoining buildings were used as collecting and dispersal yards. Now the really hard work is finished and the farm is ready for further expansion. A target of about eighty cows is set for 1971–72, with emphasis on getting even better performance than in the past.

Increased profitability

The cows are now grazed in nineteen paddocks each of about 1¼ acres. Management is simpler and in spite of heavier stocking on fewer acres grazed and a very cold and late spring, milk yields are up and concentrate useage down. Over the six-month summer period income increased by £1,015 (extra gallons £608; saving on concentrates £168 and the effect of higher milk price, £239) although there were only two additional cows compared with the previous summer.

Part of this increased profitability is due to a steady improvement of the grassland as stocking rate and fertilizer use increased. It was also due partly to an increasing confidence in the system and in the value of good grass to produce milk, using less and less concentrates. This spring all concentrate usage was stopped on 10th May, saving £20 per week on feed with no drop in yield; nor after the first day was there any more trouble with the cows in the parlour who at first were fidgety.

Mr. Hall has also become increasingly aware of the value of good autumn grass. Provided it is grown quickly with a good dresssing of nitrogen, heavy milk yields are sustained with only small quantities of cereal fed. In the autumn milk prices are good, heavy yields off grass have been very profitable without loss of condition of the cows.

Silage self feeding

The introduction of loose housing on the farm has meant that self-feeding of silage can be exploited to the full. As Philip Hall has become more confident in the quality of his silage, he has been able to reduce the feed per gallon and also to feed virtually cereal only. So, in spite of steeply increasing corn prices in 1970/71, his cost per cwt is virtually the same as in 1969/70; less corn was used and milk prices and yields were up, leading to a substantially higher profit. Overall, the margin over feed last year was more than three times what it was in 1965.

In an area where, traditionally, cows have been pampered and kept very warm, Philip Hall had serious misgivings about having an open silo with the cows in the open in all weathers; rain, hail, snow and wind—you get them all in generous measure at Making Place! However, his priorities were right for the modest capital available. First he increased the number of cows, then provided loose housing, a new parlour and eventually, when he could afford it, a covered silo. He is delighted with the performance of his cows. It is perhaps fortunate that the yard is very sheltered and traps the sun during the day, and it is therefore doubtful if the silo will ever get a roof.

Results

The following Table shows the progress made during the last six years

Year	Cow numbers	Milk production gal per cow	Concentrates fed per gallon	Margin over feed per cow	Margin over feed total	Fertilizer usage
				£	£	£
1965/66	27	899	3·6	100	2,700	243
66/67	33·5	975	3·5	107	3,584	466
67/68	42·5	1,020	3·2	124	5,270	890
68/69	51·8	976	3·2	120	6,216	1,008
69/70	59	944	3·5	113	6,667	880
70/71	61	975	2·7	137	8,380	926

It will be seen from what has been said that the figures of milk yields have been very satisfactory. This is partly because all the cows are home bred, and the increasing use of nominated proven bulls. Soon, when numbers have to be increased less rapidly, and some culling can be done on yield, still higher yields should result. Another reason for good cow performance is the fact that teat dipping is practised regularly after each milking and dry cows are treated with an antibiotic. This has meant that clinical mastitis is virtually unknown and it has been unnecessary to cull old, good milking cows because of mastitis.

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Drainage Problems in Upland Areas

E. S. Jenkins

GREAT BRITAIN is divided broadly into two physical and climatic regions—the wet uplands of the west and north and the drier lowlands of the east and south. This accounts for the main regional differences in the cropping and types of farming. Land in hill and upland areas demands particularly careful management and cropping is restricted by such difficulties as climate, stoniness, steep slopes, susceptibility to erosion and unfavourable soil texture and structure resulting in poor drainage. It is this latter difficulty and its economic solution which poses one of the major problems.

Climate and topography

A large variety of rocks of differing characteristics results in a landscape which rises from a flat coastal plain and broad flat valleys and passes through undulating countryside into a mountainous area with peaks of 2,000 feet or more and steep-sided valleys. Adjoining rock formations of differing permeability give rise to springs along their outcrops, some of which flow throughout the year whilst others are merely seasonal.

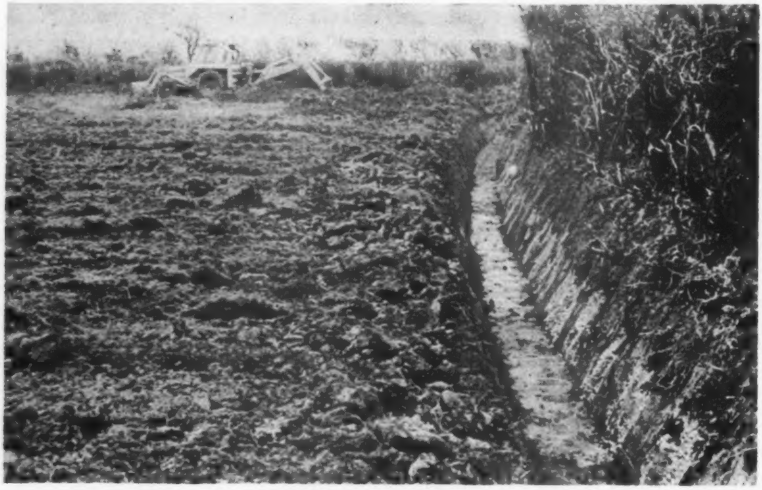
Soil patterns and types change considerably with the nature of their parent rock, situation and mode of deposition. On the flatter mountain tops and high moorland, shallow organic loams interspaced with peat areas are found overlying the impermeable rocks—these are invariably completely waterlogged. On the mountainsides and hillsides shallow soils derived from the weathered parent rock contain finer particles which are carried down by wind and rain to be deposited on the valley bottoms thus increasing the depth of soil; these soils are usually unstable and are liable to become deeply poached by stock.

The distribution and intensity of the rainfall varies considerably with the topography, ranging from as low as 40 inches on the coastline to 60 inches a few miles inland and 90 inches or more in the mountain areas. The heaviest falls are not confined solely to the mountains; storms with rainfall of up to 5 inches per hour can be experienced in areas whose annual rainfall is relatively low.

Control of surface and ground water

With the likelihood of such high rainfalls, the first and obvious step towards an improvement in field drainage is to arrange for the effective control of surplus water. Upland areas are usually well served by natural streams and provided these are maintained the farmer is normally concerned only with providing and maintaining minor carrier and interceptor ditches.

To be effective each ditch must be properly designed for its particular function. Its position is of prime importance, and interceptor ditches must be placed so that they collect surface flows so as to prevent erosion of the field surface taking place. The ditch gradient should be as uniform as possible and not too steep at any point, otherwise bed and bank scour will occur. The minimum depth must be sufficient to provide for the collection of subsoil water and give adequate margin for underdrainage outlets. The capacity must be sufficient to contain storm water within the banks as any overspill could cause erosion on the downslope side. The angle or slope of the ditch sides must be adequate to ensure stability or bank slips will result. The bed should be wide enough to allow the ditch to deal with large flows, but not so wide as to encourage shoaling and excessive weed growth in periods of low summer flow.



Seepage into a frozen ditch

Hill gripping

In areas where the agricultural value of the land or the farming output is not high enough to justify more expensive drainage, a system of small open channels, or grips, can provide a satisfactory method of dealing with surface water. There is much evidence to show that this type of simple drainage improvement has led not only to greatly improved grazing, particularly of the more palatable species in areas previously dominated by rushes and coarse grasses, but also to an increase in the sheep-carrying capacity of many hill areas and more effective control of liver fluke disease.

The system of grips should be designed so that they are drawn across major slopes to intercept the surface flows. The gradient of the channels should not exceed about 1 in 200 otherwise scour and erosion of the bed and sides may occur. The grips should have a good outlet into the existing ditches. Gripping ploughs are available to do this work; they can produce a standard-size channel at a cost of about one-tenth of that of a grip cut by hand. The tractor and plough are specially designed with a low-bearing pressure to

enable the equipment to cross very boggy areas. The tractor should preferably be equipped with winching gear so that it can if necessary winch the plough through the worst places. The finished channel is of tapered section 18 in. deep, 26–30 in. across the top and with a half round bed of 6–12 in. diameter.

Gripping systems are often designed with an intensity of 10–13 chains per acre. The intensity may vary even on the same site due to the differences in surface slope and soil type. Generally, the aim should be to average 13 chains of gripping per acre in higher rainfall areas and about 10 chains per acre on the slightly drier and lower hill slopes. The average cost is 30–50 new pence per chain, or £3·00 to £6·50 per acre.

Underdrainage systems

Not unnaturally, on the steeper slopes found in upland areas the general movement of the drainage water is downhill and so pipe drains laid across the fall have a better chance to collect it. There is a further advantage with this method in that the pipes carry the water at slower speeds, thus greatly reducing the risk of erosion at pipe joints and silting at junctions. It follows that in hill or steeply rolling land, where excess water can be traced to springs or spring lines, the drains will need to be laid strategically in order to tap or intercept the spring points or seepages.

In dealing with spring areas, particular care must be taken with the siting of the drains, because unless the flow is completely intercepted it may continue to rise to the surface or in some cases re-appear nearby. The use of permeable fill on the drains is not always necessary, but in dealing with spring lines and surface seepages it is sometimes advisable to lay permeable fill right up to ground level.

Impermeability of soils

On the lower hill and more gently rolling land, the impermeability of the soils may present the biggest drainage problem. This lack of permeability may be due to compaction or capping at the surface, or to chemical, iron or

Line of spring outbreaks

cultivation pans as well as structureless layers at depth. Some soils will be naturally massive and structureless right down the profile. Digging a hole 3–4 ft deep and examining the soil profile will reveal the subsoil conditions. The higher stocking rates on the more unstable soils tends to increase the problems of poaching and subsequent soil compaction.

Rush infestation before drainage of field

In dealing with drainage problems on impermeable soils the remedy may consist of a widely-spaced underdrainage system with a secondary treatment, such as subsoiling, to let the water permeate. A thorough underdrainage system alone will not always produce a satisfactory result under such conditions. In the wide-spaced drain system, laterals are laid to depths of 30–40 in. spaced 30–40 yards apart. Mostly a permeable backfill is laid over the pipes and brought up to within 15 in. of the field surface. Subsoiling across the underdrainage system is then carried out at a minimum 18 in. deep and at intervals of between 3 ft 6 in. and 4 ft 6 in. It is important that the subsoiling is carried out when the subsoil is as dry as possible in order to obtain the maximum shattering effect.

A crawler type or 4-wheel drive tractor is needed to provide sufficient power to pull the equipment at the specified depth and the subsoiler can either be a mounted type or a trailed mole plough/subsoiler fitted with either the mole and expander or with a special square subsoiling toe. Care should be taken to ensure that the mole or chisel toe passes through the permeable backfill and at the same time clears the top of the shallowest underdrain by at least 3 in.

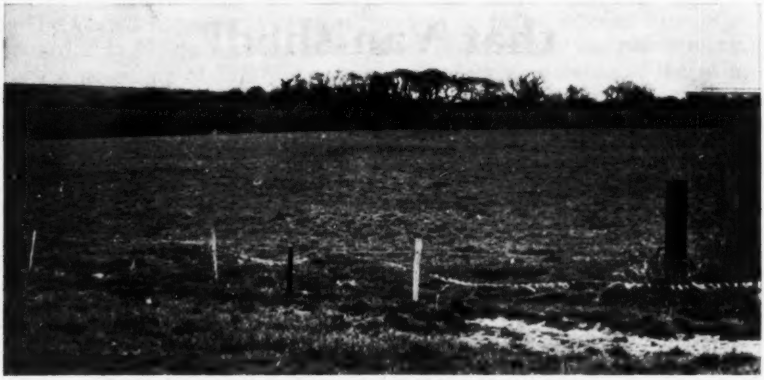
It is usually necessary to repeat subsoiling every 3–4 years to retain the right degree of soil permeability. The overall cost per acre of a typical wide-spaced system with a secondary treatment is usually £50–60 per acre. Even on the more borderline soils the results achieved more than justify a drainage expenditure of this order.

Elimination of ditches

As with the 'lowlands' there is an increasing interest in upland areas in saving on ditch and hedge maintenance and amalgamating small fields by piping some of the less important ditches. With the steeper falls and generally

less stable soils, extra care is required to ensure a sound job. When considering the elimination of ditches the overall effect on local drainage must be assessed and the nature conservation aspects should always be taken into account.

The replacement of open ditches with comparatively small-size pipes is an operation which requires special care and this is particularly true in upland



Same field as photograph opposite after drainage

districts where the high rainfall and steep gradients can lead to special problems. The injudicious use of this technique in such areas increases the risk of soil erosion by uncontrolled surface run-off. Consideration should also be given to the likely effects of blockages at any point in the pipeline and the necessary safeguards taken. Cement jointing of the pipes is frequently needed to prevent their displacement, and some gradients are so steep that it is necessary to include drop manholes at intervals to check the high flow velocity; others will also be required at major changes in gradient or direction. The cost of piping is often high in relation to the benefit obtained in upland areas, and where the required pipe size exceeds 9 in. diameter the proposal should be given a long, hard look. The average cost of a typical 9 in. diameter pipe-drain may be £1·50 to £2·00 per yard run.

Conclusion

In the writer's view it is well worth considering one of the cheaper forms of drainage improvement even on poor soils in high rainfall districts with comparatively low return farming systems. Furthermore, on well-drained and managed grassland the incidence of liver fluke and similar parasites is much reduced and it is very worth while to drain the stock wintering fields to make them safe.

The author acknowledges the assistance given by Mr. D. J. B. Edmonds, C. Eng., A.R.I.C.S., A.M.I.Mun.E., M.I.Agr.E., with the preparation of this article.

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The Butter Mountain that Vanished!

THE price of butter in mid-1970 was hardly higher than it had been ten years earlier. Now, a year later, butter is much more expensive. Our main supplier, New Zealand, has raised its price to us by about 60 per cent, to £527 a ton (4th October 1971) for packet butter. The price of butter from Denmark, our second most important supplier, has gone up at the wholesale level from £388 a ton to £580 a ton (4th October 1971). Why has the price of this commodity, which people had almost come to believe should remain fixed in price for ever, suddenly make such a great leap forward?

The reason is that butter production is still responsive to market pressures, even though for years this has not been very apparent. It is now reflecting the economic pressures that over-supply exerts on production. The continual low prices on the world market have convinced many dairy farmers that they would earn more money doing something else. They have, therefore, sold or slaughtered their herds and moved out. Anxious to reduce the very large subsidies needed to get rid of surplus production, Governments have encouraged this exodus by providing financial incentives for a switch from dairy production to alternative agricultural enterprises such as beef, arable farming, or even forestry. Social factors also have an effect for it is hard work running a dairy farm seven days a week.

This process of decline began in Europe in 1969, but world over-production was such that the reduction was unnoticeable and the accumulation of surplus stocks was only marginally reduced. But in 1970 nature took a hand. Europe had a cold spring which cut back milk deliveries. There was a drought in New Zealand; her cows faltered before coming into production and then dried up prematurely, reducing the season's supplies. In Australia, drought was followed by severe flooding. The United Kingdom market felt the effect in November when European production normally gives way to the new season's arrivals from the Southern Hemisphere. These were late and the United Kingdom trade was confronted for the first time for many years with a situation of tight supply. Prices became firmer.

U.K. supplies

The United Kingdom market has for many years been protected by a quota system designed to prevent prices becoming depressed by gross over-supply. In November 1970 changes were made in the annual quota allocation to draw in more butter from Europe. By January, Southern Hemisphere supplies were still below normal and a further re-allocation of 12,000 tons was made. The effect on European production of the move out of dairy farming now began to be felt. The famous European Economic Community

butter mountain did not instantly disgorge 12,000 tons for United Kingdom consumption. It suddenly seemed to have become more distant, and all at once no one appeared quite certain exactly where it was. In fact, it wasn't! The measures taken by the E.E.C. since 1969 to reduce it had succeeded and little more remained than the normal working stock required to carry the E.E.C. countries through the winter.

The United Kingdom is greatly dependent on butter supplies from other countries; in 1970 we produced only about 13 per cent of our requirements. By the beginning of 1971 our overseas suppliers were aware of the swing from a buyer's to a seller's market. The United Kingdom trade, with some stocks in hand, was able to slow down the price rises until March. In an effort to find more butter, Western Germany and Canada were added to the authorized suppliers and special arrangements were made in order to seek early delivery of 10,000 tons in April. Some extra butter was found in this way, but supplies were much affected by the decision of the E.E.C. to cut its export restitution for butter in order to conserve sufficient stocks for its own home market.

At the end of April the Government took further and more far-reaching action. The quota system was supplemented by a new system of open individual licences, which allows the United Kingdom trade complete freedom to import butter in any quantity from any producing country. Thus the price which the housewife pays for butter is determined at the present time only by the availability of butter in the world, not by any Government action whatever. The free market has so far brought small quantities of extra supplies to the United Kingdom, including several thousand tons from the U.S.A.

Future trend

United Kingdom butter producers are now supplying an increasing share of total consumption and marketing of their packet brand is making very good progress. But elsewhere evidence is accumulating to show that the downward trend of European production will not quickly be reversed. It is estimated that the European Economic Community's self-sufficiency in butter fell from 118 per cent in 1968 to 107 per cent in 1969 and to 100 per cent in 1970. All over the world cheese consumption is buoyant and its production is taking more milk. Although butter surpluses may still appear they should be dealt with more promptly than before so that they will not reach the proportions of previous years.

Just reminiscing . . .

The Sporting Pig

John L. Jones

OVER the years pigs have earned a very unjust reputation for being dirty, whereas it is well known to all who work with them that, given the opportunity, they are the cleanest of animals. But the pig has passed into popular myth as the synonym of dirt, and the millstones of 'dirty pig' and 'filthy swine' hang heavily round its neck.

The pig, however, has kept its nose clean in another direction. Its intelligence has never been impugned. The sheep is the traditional symbol of silliness, with the ox running a close second for stupidity, although there is some evidence that the intelligence of the ox has been underestimated. But the pig is undoubtedly superior to both in brain power.

The gun-pig

Among the many case histories that go to prove this, none is better documented or more colourful than the case of a black sow born in the New Forest in the early part of the nineteenth century. Her breed was of the type that lived semi-wild, foraging for acorns, mast and rhizomes, and receiving food from her owner only when she was suckling her litters, and then only for a short period of lactation. Her claim to fame began almost by accident. She had become the property of a gamekeeper when she was three months old, the gift of a fellow keeper in the Forest. One day the keepers were engaged in breaking a not very good bunch of pointers and setters to the gun and were being loudly critical of the lack of talent, when a very active and stylish black sow came trotting towards them. She roused admiration for her particularly alert and intelligent demeanour, approached them fearlessly and gruntingly accepted a piece of oatmeal cake. The light-hearted suggestion was made that they should train her to the gun—she couldn't be any worse than this lot of dogs anyhow— and so began the career of the most famous gun-pig in English history.

The first need was for a name to which she could be trained to respond, and because she was somewhat soiled from having been wallowing in a bog, she was christened Slut. She learned to acknowledge her name within the course of a day and never forgot it during a long working life. Within a fortnight we have it on unimpeachable evidence that she was as good as the best pointer and retriever in all England during the nineteenth century.

Slut hunted with the guns in the open glades of the New Forest, on moorland and on heaths. In the same day she was known to find and point

partridges, black-game, pheasant and rabbits. Her sense of smell and movement was remarkable, and she was often known to point a partridge more than 40 yards away, with her nose in perfect line and remaining motionless until the game moved. She would even point jack-snipe, which is perhaps the most testing measure of a pointer's skill. Within a few weeks she was also reputed to be retrieving as well as any trained dog in England; with one exception, for Slut inexplicably was never known to point or retrieve a hare.

Slut as she might have been seen retrieving game during her unique career as a gun-pig

Slut was not a favourite with the gun-dogs, and a contemporary describes how the dogs always 'dropped their sterns and showed symptoms of jealousy' when this interloping swine joined them on the shoot. Even after she was trained, Slut chose to sleep in the forest, but spent her time not far from the edge of the wood so that she was always on call at the gamekeeper's whistle. Her pace when working with the guns is described as a steady, controlled trot. The only times she galloped were when the whistle flushed her out of the forest and there are numerous testimonies to her responsive delight, as unmistakable as that of any dog, at the sight of the gun.

When Slut was five years old her first master died and she was sold with his pointers and retrievers to a new owner who was a well-known sporting baronet. She changed owners yet again before she was ten years old, by which time she had become something of a legend, with sportsmen coming from far afield to see her in action.

By this age, however, we are informed that she had become 'fat and slothful though she could point as well as ever'. Slut came to a sticky end through being suspected of making killing raids on local flocks and eating lambs. When she died at the ripe old age of ten years she had attained the truly gargantuan weight of 700 lb.

Other sporting pigs

Slut was but one, though certainly the most famous, of British sporting pigs. Tradition has it that the pig was quite frequently pressed into sporting service as a result of the inhuman laws on poaching and of the practice of disabling the dogs of commoners and swineherds. This was done by cutting off three claws from the dog's right front foot so that he could not run fast enough to hunt. Readers of Scott's *Ivanhoe* may recall the early scene in the forest of the West Riding where the swineherd's dog 'Fangs, a sort of lurcher, half mastiff which ran limping through the forest', and the anger of the swineherd at the 'Ranger of the forest that cuts the foreclaws off our dogs and makes them unfit for their trade'. In those days the hunting pig would arouse no suspicion, whereas the presence of a dog brought terrible punishment on the owner.

Traditionally, it would seem that the pig could also be trained for purposes other than pointing and retrieving, particularly for draft. Pig histories mention a Hertfordshire farmer in the early nineteenth century who always rode in a carriage driving a four-in-hand team of draft pigs. He is rumoured to have made quite a stir in St. Albans market place on his first visit in his 'chaise-cart drawn by four hogs at a brisk trot', and to have refused fifty pounds cash for the team, quite a sum of money in those days. It took six months to break the pigs to the shafts. In Scotland, 150 years ago in the area between the Spey and Elgin, it was a not uncommon sight to see 'a cow, a sow and two young horses yolked together in a plough and the sow the best drawer of the lot' There are numerous accounts of pigs being used as riding animals by children and of being kept as household pets.

The sporting pig was initially a product of the harsh forest laws and later, as in the case of the famous Slut, of the wealth and eccentricity of the sporting gentry. Pigs are now firmly and for ever in the sty, if such a homely description can be applied to the controlled environments where more and more baconers and porkers pass their shorter and shorter lives. The principal remaining exception is in France, where the keen-nosed pig with its enormously strong cartilaginous snout is still the favoured instrument for the smelling and digging out of truffles, those mysterious gourmet fungi growing without root or leaf in the dark glades of the Perigord forests.

John L. Jones, B.A., is an agricultural journalist with a special interest in arable farming in Britain.

Approved Chemical Agents for the Cleansing of Dairy Equipment

A supplementary list of products approved by the Minister of Agriculture, Fisheries and Food and the Secretary of State for Social Services as chemical agents for use in the cleansing of dairy equipment (FSH 5/71) * has been issued to local authorities in England and Wales. The list includes all chemical agents approved between 1st January and 30th June, 1971, for use under Regulation 27(6) of the Milk and Dairies (General) Regulations 1959.

**Copies of the supplementary list can be obtained from H.M. Stationery Office, at the addresses shown on page 510, price 5p (by post 7½p).*

Timber Preservation

E. Dunmore, *Land Arm, A.D.A.S., London*

In this country the main agents of decay in timber are certain species of fungus and wood-boring beetle. Of these, fungal attack is more likely to cause serious structural damage, although insect attack can be extensive enough in old buildings to be structurally significant. Timber exposed to sea water is also liable to be invaded by marine borers.

Fungal attack starts with spores which are always present in the air. When these settle on timber where moisture and temperature conditions are suitable they germinate, and the resulting fungoid growth can spread throughout the timber, feeding on it and destroying its cellular structure. Timber with a moisture content of less than 20 per cent is not usually affected.

Insect attack commences with the adult beetle laying her eggs in crevices in the timber surface. These hatch into larvae which tunnel their way through the timber and feed on it for a number of years before emerging as adults to recommence the life cycle. Dry timber is readily attacked by beetle, but the attack is usually confined to the sapwood.

Preservative treatment of timber can help to safeguard against these agents of decay. The various treatments available are described below. However, before deciding which treatment is most likely to be satisfactory in a particular situation, it is necessary to take into account the species of timber to be used, its intended useful life, and the extent to which it will be subject to dampness or humidity. Some timbers are naturally resistant to fungal attack, such as the heartwood of Western red cedar, larch, oak, chestnut, and a number of tropical hardwoods. But many hardwoods and the majority of softwoods are non-durable, as is the sapwood of all timbers, whether hardwood or softwood.

Decay conditions

The situations most conducive to decay are those where timber is liable to remain damp for long periods with little or no chance of drying out. Examples are those in contact with the ground or other damp material, those subject to considerable surface or internal condensation, and those exposed for long periods to a very damp atmosphere, e.g., over 90 per cent relative humidity. Timbers built into brickwork or concrete, etc., where little or no air movement is possible, can also decay should they become damp. Timber exposed to the weather but not in contact with the ground (e.g., cladding and door and window joinery) requires some protection, but because such timber is able to dry out periodically, the ability of fungal attack to develop fully is considerably reduced.

Preservatives

Timber preservatives may be classified into three main groups: the tar oils, water-borne preservatives and organic solvent type preservatives.

The tar oils, or creosotes, are distillates of coal tar. They are resistant to leaching (i.e., dissolving out in water) and are particularly suitable for timbers used externally or in contact with the ground. Their characteristic odour makes them less suitable for internal timbers, especially where living plants or stored crops which can be affected by tainting are involved. Without the application of a sealing coat, treated timbers cannot be painted successfully with ordinary paints, as the creosote tends to 'bleed' through and cause discoloration.

Water-borne preservatives are solutions in water of various inorganic salts, often compounds of copper, chromium and arsenic. After impregnation with some of these preservatives, the salts used become chemically fixed within the cell structure of the timber and cannot then be leached out. These types are very suitable for use on timbers which are in contact with the ground. Generally, water-borne preservatives can be used for both external and internal timbers, and they can be painted over. In some of them, fire retardant chemicals are also included. One disadvantage, however, is that treatment with them increases the moisture content of the timber, which must usually be re-dried before use.

Organic solvent type preservatives are solutions of various organic compounds (e.g., naphthenates, pentachlorphenol, tributyltin oxide, etc.) in an organic solvent such as white spirit. They tend to be more expensive than the other groups, and are normally used only for surface treatments. Most are resistant to leaching, and all can be readily painted over. Some have waxes or resins included in the formulation to provide water-repellant properties.

Application methods

Methods of application of preservatives vary from pressure impregnation to spraying or brushing. The choice of method will depend mainly upon the degree of penetration required to provide adequate protection and the permeability of the timber species concerned.

Pressure impregnation is the most effective treatment and should be used for all timber in contact with the ground or in similar adverse conditions. The process is carried out in a pressure cylinder. Creosote or a water-borne preservative is forced into the timber under pressure for periods varying from one to six hours, usually followed by vacuum to adjust the absorption and remove excess preservative from the timber. In some cases the treatment is preceded by a period under vacuum. The plant required is costly and likely to be beyond the resources of all but the larger estates. There are, however, a number of commercial firms equipped to treat timber by this method.

The hot and cold open tank process is almost as effective as pressure impregnation for comparatively small section timbers such as fence posts. The timber is submerged in preservative (usually creosote) in an open tank, which is heated to around 80°C for about an hour and then allowed to cool. This treatment is well suited to estate work as the equipment required is fairly simple.

The double-vacuum and liquified gas processes are both methods of treating timber in pressure chambers with organic solvent type preservatives. Fairly deep penetration of permeable timbers can be achieved. The processes have been introduced into this country only recently and as yet only a small number of firms have the necessary equipment to carry them out.

Immersion, spraying and brushing are all non-pressure methods of application and, except for long immersion (up to 24 hours) of fairly small section permeable timbers, provide only surface protection. The preservatives used are creosote or organic solvent types. These methods are normally used for internal timbers or external joinery which is to be painted. The latter is, of course, treated with organic solvent type preservatives and not with creosote. Timber used externally and unpainted (e.g., cladding) can be treated by immersion for 30–60 minutes, provided the timber is a pine species and does not have to come in contact with the ground or other damp material.

'Timborising' is a diffusion process using di-sodium octaborate solution. It is carried out directly the timber is felled and while it is still green. Timber treated by this method should be used only in dry situations, as the preservative readily leaches out.

Precautions

It should be remembered that many of the chemicals used as fungicides and insecticides are extremely poisonous, and full safety precautions should be observed during their application. Attention should also be given to the subsequent use of the timber, and whether the preservative treatment chosen is likely to adversely affect animals, plants or crops. For example, the only recommended preservative for timber mushroom boxes is pentachlorphenol, and for fruit boxes copper 8-hydroxy quinolinolate.

Ministry Publications

Since the list published in the October 1971 issue of *Agriculture* (p. 455) the following publications have been issued.

FREE ISSUE

ADVISORY LEAFLETS

- No. 10. Fruit Tree Red Spider Mite (Revised)
- No. 205. Apple Powdery Mildew (Revised)
- No. 318. The Mole (Revised)

SHORT TERM LEAFLETS

- No. 28. Glasshouse Construction—Siting and Design (Revised)
- No. 127. Milk Cooling on the Farm (New)
- No. 132. Fruit Handling and Packhouse Mechanization (New)

Single copies of these leaflets are obtainable from the Ministry of Agriculture, Fisheries and Food (Publications), Tolcarne Drive, Pinner, Middlesex HA5 2DT.

in brief

- **Statisticswise**
- **The passing of the N.D.A.**
- **Harvesting dry peas**

Statisticswise

IT is not only in the competitive world of beauty contests that statistics are vital. The annual exercise known to, if not beloved by, farmers as the 4th June Agricultural Returns qualifies unequivocally for that designation; for this twelve-monthly stocktaking is in the nature of a reconnaissance to assist the strategy of farming policy. Over-the-hedge computations and judgments, however knowledgeably expressed, suffer from too local a viewpoint and are often subjective—even wishful. Thus that farmhouse chore of form filling does serve a supremely important purpose to measure the strength and weaknesses in the farming structure, the foreshadowing of trends and the resources which the land is contributing to the gross national product.

The farming statistics for 1971, though provisional, reveal 3 per cent more land to have been under cereals than a year ago—some 237,000 acres in fact. Wheat, covering 2,604,000 acres, showed an increase of 8·7 per cent over 1970, barley only 1·4 per cent and oats 1·3 per cent. The mixed corn acreage, however, was down from 165,000 acres to 117,000 acres. The acreage of sugar beet for processing was up, totalling 458,000 acres as compared with 450,000 acres in 1970. But the area under potatoes fell by 26,000 acres (5·1%) and fodder crops (including beans for stockfeeding) by 46,000 acres (8·3%). The area of land in permanent grass has continued its decline during the year by 142,000 acres (1·4%), whilst the acreage of temporary grass, including lucerne, has risen by 60,000 (1·7%).

On the livestock side the outstanding features have been a marked fall in the number of poultry and a 4·4 per cent increase in beef animals. First poultry; the present figure stands at 104·9 million, compared with 110·7 million in 1970. Fowl pest must bear some of the responsibility for this, but there have also been fewer demands on hatcheries. Growing pullets (from day old to point of lay) show a drop of over 2 million and now correspond closely, at 17·3 million, with the fractionally higher figure for 1969. Broilers and other table birds were down by 2¼ million (5·2%). There were also half a million fewer turkeys, and geese numbers also declined, but the duck population is seen to have increased by 3·1 per cent to 37,000.

The total of beef type and dairy type cows increased by about 20,000 (0·6%) over 1970, the beef herd rising by 29,000 (4·4%) and the dairy herd, continuing to contract, falling by 10,000 (0·4%). But whereas the number of in-calf heifers (first calf) has decreased over the year by 23,000 (3·6%), the number of calves under one year old has risen by 46,000 (1·8%).

The sheep breeding flock, including shearling ewes, is 0·8 per cent lower than it was a year ago, but there were 45,000 more lambs under one year old, which is an increase of 0·5 per cent. The total of pigs in the national breeding herd shows an increase of 7,000 (0·8%) since March 1971, but this is less than the normal seasonal rise. Although the herd has risen by 41,000 (5·3%) over the year 1970–71, within the breeding herd, totalling 805,000, the number of gilts in pig has fallen by 1,000 during the last quarter and by 23,000 (18%) compared with June 1970.

The total farm labour force, excluding farmers, partners and directors, is now 350,000, of which male workers account for 254,000. It is of interest to note that while the number of regular whole-time male workers had fallen by 5,000 since June last year, the number of regular whole-time women workers has increased by 2,500—a jump of 11 per cent—and an increase of 3,000 in the number of regular part-time workers is wholly accounted for by women. It must be added, however, that the figures relating to female employment may have been affected by an understatement in the June 1970 analysis.

The passing of the N.D.A.

AWARD of the National Diploma of Agriculture, which for so many years has been the first rung on the career ladder for so many students entering the agricultural industry, passes into obsolescence this year. In its stead, geared more closely to the requirements of a new farming world, will be the Ordinary National Diploma and the Higher National Diploma which were recommended by the Pilkington Committee, who wished to see greater emphasis placed on the *practice* of farming. The three-year courses, at both national and county farm colleges, which will lead to these scholastic distinctions are already a year old at some colleges; they comprise an initial year at college, followed by a year or so on a farm and finishing with a further year at college. This is the so-called 'sandwich' course, with the meat of down-to-earth farming as the filling in the middle.

The passing of the N.D.A. will be regretted in certain quarters (not least perhaps in some colleges) but not generally within the wider areas of the industry and its ancillaries, nor by many farmers who were looking primarily at its practical value rather than its theoretical promise. The vision of the farm manager's baton in every farming student's knapsack has been fading for years. What the new concepts hope to achieve is the more realistic one of qualified men and women in the right job and fully trained to keep abreast of technical and technological advances.

But if farmers have in the past criticized the old N.D.A. from the sidelines, they now have the opportunity of helping to make the new diploma courses a success, for without their co-operation in readily taking and training students the whole idea qualifies only for a similar requiem. Fundamentally, the new plans in agricultural education, including the extensions which are currently being examined by a new committee under the chairmanship of Professor John Hudson, are an investment in the future of British agriculture and one in which the experienced farmer can extend a helping hand to the young aspirant.

Harvesting dry peas

OVER four years' experience in the methods of harvesting dry peas at the Ministry's Experimental Husbandry Farm at Terrington in Norfolk has consistently favoured four-poling. The peas have always been of a better colour and usually with less staining than when windrowed or treated with desiccants. A possible alternative to four-poles, which is reputed to offer the same advantages, is the use of hut-racks. Terrington experimented with a small number of these for the first time last year and obtained an equally good sample of peas as from four-poles. The use of hut-racks would also seem to offer advantages in manpower. Reporting this in their current annual review, the Farm says that a rather higher work rate in terms of peas loaded per man-day was recorded when loading hut-racks with a front-mounted buckrake and two men than when loading four-poles by hand. However, more hut-racks than four-poles are needed per acre and each set is more expensive. Terrington is continuing the study of the use of hut-racks this year and eventually it is hoped to collect enough information to enable a full and fair comparison of the two methods to be made.

AGRIC

Farming Cameo: Series 5

2. Bedfordshire

W. E. H. Telford

BEDFORDSHIRE is an intensive arable and market-gardening county of just under a quarter of a million productive acres. Like the rest of eastern England it enjoys a low rainfall (22–24 inches per annum) and the climatic conditions are eminently suited to intensive crop production.

The considerable market-garden industry, which initially developed around the towns of Biggleswade, Potton and Sandy, subsequently spread into other areas, mainly in mid-Bedfordshire. Supplies of fresh vegetables produced in these areas of the county have been traditionally marketed in London, the Midlands and the North for a great many years.

In spite of recent urban and industrial development around the county town of Bedford, and of Luton and Dunstable in the south, the county is still mainly rural; but faster road and rail communications are increasing the London commuter population in many of the villages and hamlets. The average rate at which agricultural land has been taken over for non-agricultural development each year rose to as high as 1,000 acres during 1955–1964, and has since fallen slightly to 870 acres annually in 1965–1970.

Soils and farming systems

Although the soils are very variable, there are four main geological formations which occur in large and well-defined areas. These characterize and have a great influence on the farming systems of the county.

The largest group, the Chalky Boulder Clays of North Bedfordshire, covers most of the area north of Bedford and the River Ouse and a fairly large area south and west of it. This is typical rolling countryside with mild undulations dividing wide valleys and flat plains made up of large farms with spacious fields which have been created by hedge and ditch removal. It is a well-farmed and highly productive area.

The Lower Greensand formation of mid-Bedfordshire runs as a ridge in a north-east/south-west direction across the middle of the county roughly from Sandy to Leighton Buzzard. There are extensive woodlands and attractive scenery in this part of the county; agriculturally, the soils, though again very variable, make it the home of the market-gardening industry. It was in this area that Brussels sprout growing began more than 150 years ago. The National Institute of Agricultural Engineering, the National College of Agricultural Engineering, Shuttleworth College, and the headquarters of the Royal Society for the Protection of Birds are all located here.

The Chalk Down formation of South Bedfordshire commences as a steep escarpment at Streatly and continues southwards to the county boundary. This formation characterizes the countryside round Luton and Whipsnade, where the Chilterns rise up to over 800 feet—the highest point in the east of England and very popular with gliding enthusiasts. The farms in this area tend to be large, mainly arable and highly mechanized, with cereal production predominating.

The Oxford Clay formation of the Marston Valley area lies to the south-west of Bedford and runs across to the Buckinghamshire border. Here is the heart of the largest brickwork industry in England and, as a result, agricultural production is of secondary importance, though not insignificant.

Cropping

There are about 1,900 holdings in the county, of which 30 per cent are over 100 acres in size and represent 84 per cent of the total productive acreage. The total labour force halved in number between 1950 and 1970; even more significantly, the number of regular male workers declined by 25 per cent in the four-year period 1966–1970.

With the continued and rapid fall in the agricultural labour force, systems of mechanization have developed equally rapidly, not only in arable crop production, but also in horticultural production and harvesting methods.

The Land Settlement Association have two centres in the county covering about 500 acres. Both are primarily horticultural with intensive glass.

County Council smallholdings cover 11,500 acres for about 360 tenants. These are mostly market-garden units but there are some intensive dairy holdings.

Agriculture. Of the total productive area in 1970, cereals represented 57·2 per cent, break crops 25·5 per cent and permanent grass 17·3 per cent, a ratio of cereals to break crops of 2:1. Traditionally, the wheat acreage has always exceeded that of barley, but since 1959 the position has been reversed, and since 1966 there have been two acres of barley for every one of wheat. Oats represented only 2·6 per cent of the area in 1970.

Approximately 9,000 acres of potatoes and 1,600 acres of sugar beet are grown in the county. Roots and green crops for livestock now occupy an insignificant area.

Horticulture. For a long time Bedfordshire has been one of the major market-gardening counties in the country. Many vegetables are now grown on farms in rotation with potatoes and corn, but smallholdings are still numerous and many are fragmented. Brussels sprouts is the outstanding crop with about 12,000 acres grown annually—almost a third of the national total. Other important crops such as cabbage, runner beans, lettuce and beetroot are grown extensively in the main market-gardening areas.

Glasshouse crops occupy about 130 acres and the area is increasing; some 400 acres are devoted to outdoor flower production, Biggleswade being a notable centre.

Grass. In 1939, 50·8 per cent of the productive acreage was in permanent grass. By 1944 this was reduced to 23·5 per cent and today lucerne, clovers and temporary grasses amount to only 6 per cent.

Livestock

Pigs are very popular and numerous and there are several noted breeders of pedigree Large White and Landrace herds. Commercial production of heavy hogs, baconers and porkers integrates well with the intensive horticultural smallholding and the large arable farm.

There are less than 150 registered milk producers in the county although the size of the dairy herd has increased. To some extent beef production has tended to increase, but this is very limited.

For various reasons, including the shortage of skilled labour, sheep numbers continue to fall annually.

Poultry is largely devoted to egg production and, as with other classes of stock, flock sizes increase as the number of holdings with poultry become smaller. Broiler production is almost entirely confined to two large specialist units which have a combined capacity of around 350,000 birds per crop.

Books

Animal Traps and Trapping. James A. Bateman. David and Charles, 1971. £3·50 net.

There are many fields of interest in the use of traps and trapping techniques. Many people, including naturalists, scientists, farmers, gamekeepers, fishermen, pest control services and the inventors and manufacturers of traps will find something of interest in this book. The amount of research into the origin, development and use of many of the devices described and illustrated must have been a formidable task.

Although there is much information on the setting and action of the traps, the book is not so much a handbook of instruction for the practical trapper as a comprehensive accumulation of information on all forms of trapping including historical records from many parts of the world.

The author could perhaps have been more careful with the illustrations, for although the hundred or so chosen cover the various types of traps very well, unfortunately the drawings vary considerably in quality and are sometimes incomplete. For example the Eclipse trap is minus the cone partition dividing the catching end from the 'holding' compartment, the Chardonneret trap is the wrong shape and shows a lid (trap door) that could not possibly close securely. The log-cage deadfall has the wrong trip mechanism and would probably fall backwards if an attempt was made to set it in this manner. Photographs of two of the mammal traps (the full-barrel and the Sawyer) could be misleading if the author is implying that the traps are so set when ready for use; and the Lloyd trap could not function in a tunnel of the size shown.

Many of the snares are shown on the 'bender' principle but the word 'bender' although very commonly used by practical trappers, is not referred to in the text.

The chapter on 'The traps of nature' will be of wide interest. There must be many trap users who had not realized that very efficient natural traps existed on this planet long before man. If we are to stay within the law the chapter on 'Trap legislation' must be commended, for however we may feel about the present day restrictions, some of those placed on our forefathers were much more drastic.

The use of correct baits and lures form an important part of the trapper's art; this is covered in chapter nine where suggestions and advice are given on the methods used to tempt a wide range of animals. Most trappers will have their own well-tried techniques and it is in this field that opinions among trappers usually differ most.

There can be no doubt that trapping is a very controversial subject. The chapter 'The ethics of trapping' gives much food for thought. The author has handled this aspect in a clear, concise way and this is the chapter with the widest interest of all in this well written, very readable book.

C.A.S.

The Oaklands Story 1921-1971. E. C. Pelham. The Hertfordshire College of Agriculture and Horticulture, 1971. 65*p*.

This well illustrated and excellently produced paperback type booklet is a most interesting history of the origin and development of 'Oaklands', since 1966 officially entitled the Hertfordshire College of Agriculture and Horticulture. On the face of it such a story is unlikely to be particularly interesting except to those involved in the trials and tribulations of setting such an institution on its feet and making its reputation. But Oaklands is an unusual place with a remarkable history well worth recording in the affectionate detail the author has painstakingly assembled.

In 1920 the County Council bought Oaklands Park mansion, cottages, buildings and 335 acres of land for £34,000; not at all a bad investment as things have turned out! Moreover, the investment in people has been just as fortunate. A dedicated staff, among whom the name of John Hunter-Smith is first, well supported by the County Council and a number of far-sighted farmers, began to make Oaklands a significant influence in agricultural and horticultural education. Among the respected Hertfordshire names, one early governor was a certain Dr. E. J. Russell, who was to become very eminent indeed. Other men in the Oaklands story, staff and pupils—or in other ways associated with its work—make considerable reputations there or elsewhere: C. E. Hudson the well-loved and respected horticulturist, Robert Rae, Professor at Reading and an early Director of the N.A.A.S., L. F. Clift, J. W. Reid and many others too numerous to list here. Oaklands men are to be found in many parts and links abroad have brought overseas students there. They seem to have had a good time in spite of the sobering effects of the College motto 'Work and Learn'. That forbidding imperative did not prevent a wide range of student activity, including amateur dramatics, sports and even a chariot race.

It sounds a thoroughly busy, attractive and lively place and those fortunate to attend the College must be conscious of their debt to it. But it is significant that, with all its scholastic attainments, the frontispiece to the book shows a group of students sitting on a load of hay and the caption appropriate to the photo and the college history is 'what fun we had'.

Copies of the booklet can be obtained from Hertfordshire College of Agriculture and Horticulture, Oaklands, St. Albans, Hertfordshire.

R.G.A.L.

The Domesday Geography of Midland England. Second Edition. Edited by H. C. Darby and I. B. Terrett. Cambridge University Press, 1971. £10.

Scholastic probings into that monumental inventory of eleventh century England known as the Domesday Book has produced a wealth of material that has steadily been woven into the tapestry of our history. Less attention has been given to it as a source from which the geography of England during the early middle ages could be reconstructed. This is the aim of the editors and their team of contributors in the massive, specialized work of seven volumes, *The Domesday Geography of England*, of which five have already been published and the considerably revised edition of Vol. 2 is now issued.

Had William I's commissioners realized the potential value of their laborious survey to twentieth century researchers, the deficiencies might have been fewer and so eased the burden of interpretation and gap-filling which has formed part of their legacy. But as the authors remind us, great as is the bulk of the Domesday Book, it is only a summary and was designed essentially for a fiscal purpose; much is omitted and much is obscure. Whatever the frustrations, however, with which the authors of the present series have had to contend, their resultant text, supplemented in great detail by maps and tables, gives a uniquely informative picture of the contemporary countryside and the economic life and relative prosperity of the different areas related to, but not precisely identical with, the counties as they are mapped today. The disparites between modern county boundaries and those in 1086 are common to most and particularly marked for Worcestershire, Gloucestershire and Warwickshire. Similarly, those counties bordering Wales are ill-defined under the ebb and flow of armed conflict in the years immediately following the Norman Conquest.

This volume comprises the studies of Gloucestershire, Herefordshire, Shropshire, Staffordshire, Worcestershire, Warwickshire, Leicestershire, Rutland and Northamptonshire, each with a regional summary. The incidence of pasture and meadowland, wastes, woodland and forest, settlements and markets, etc. have been wrested from the old folios to reveal the local economic variations that patterned the lives of a people on the threshold of a new era. As such, and for its long-term student value, this indefatigable work cannot be praised too highly.

S.R.O'H.

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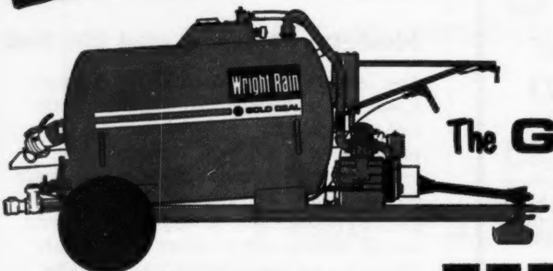

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